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Recent ion cyclotron resonance heating experiments in JET in preparation of a DT campaign

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Ion cyclotron resonance heating (ICRH) is a powerful and flexible method, which can make a significant contribution to a future DT campaign on JET. It can be used for direct fuel ion heating or for minority ion heating, in the latter case leading to electron heating via Coulomb collisions of the fast minority ions with the electrons. Some ICRH schemes can also directly enhance nuclear reaction rates by accelerating fuel ions to energies near the maximum of the fusion cross sections, others allow performing tasks such as wall conditioning, controlling MHD instabilities and expelling heavy impurities from the plasma core. Since 2011 JET is equipped with an "ITER-like"Beryllium wall and a Tungsten divertor, making it prone to high Z impurity accumulation, which frequently leads to a core radiation collapse. ICRH, using Hydrogen minority heating at sufficiently high power (~4MW in JET), is already well known to be an effective tool for preventing core impurity accumulation and the resulting radiation collapse, and is routinely used on JET. Here we report on initial successes of an important part of the JET work programme on ICRH applications, which is to investigate whether ICRH scenarios can be found that simultaneously achieve 2 or more of the above listed beneficial effects. In view of the demonstrated ability of 3He minority heating of substantially increasing the fusion reactivity in D-T plasmas, the potential of this heating scheme to also prevent impurity accumulation was evaluated. Anticipating that 3He heating alone may not be suitably efficient for impurity control, a combination relying on using 2 distinct frequencies to simultaneously heat H and 3He minorities was also tested.

Sophisticated modeling tools are a key asset to optimally prepare for ITER. Various recent experiments provide a wealth of data to benchmark such codes. Modeling results highlighting the ICRH dynamics will be presented. It was e.g. also found that there is considerable potential in exploiting synergies between Neutral Beam Heating and ICRH, due the favorable dependence of ICRH absorption on the resonating ion's Larmor radius, particularly at higher cyclotron harmonics.

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